CAMBRIDGE SYSTEMATICS

Ridership and Revenue Forecasting for the Finance Plan

technical

report

prepared for

Calilfornia High-Speed Rail Authority

prepared by

Cambridge Systematics, Inc.

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This technical report summarizes Cambridge Systematics' (CS) technical work completed to date under contract with the California High-Speed Rail (HSR) Program Management Team (PMT). Technical work completed by CS included refinement and validation of prior work, addition of post-processors for output reporting, and ridership and revenue analysis of system phasing options.

■ Review and Refinement of Prior Forecasts

In June 2008, CS initiated further due diligence review of travel forecasts produced for the HSR Authority and PMT. The due diligence review was overseen by senior CS mangers not involved with the development of the HSR ridership forecasting process or the various travel forecasts performed during 2007 and early 2008. Thus, this due diligence review supplemented earlier quality control work that included a peer review process.

The due diligence review uncovered several issues with the travel forecasts that had not been detected during the production of the ridership forecasts for the Bay Area to Central Valley Program-Level Environmental Impact Report and Tier 1 Environmental Impact Statement (BACV EIR/S). Addressing the issues produced both positive and negative changes to the forecasts with the net effect of the changes being a decrease in interregional ridership. Table 1 summarizes the forecast interregional HSR ridership for the primary alternatives using Altamont Pass and Pacheco Pass.

The issues and the relative impact that addressing each had on the interregional ridership forecast are discussed below. The relative impacts that addressing each issue had on total trip making, interregional HSR ridership, and interregional HSR mode share are shown in Table 2. The values shown in Table 2 are for relative comparison only. Since the issues were addressed incrementally (e.g., interim forecasts resulting from adjustments addressing the second issue also included the impacts resulting from addressing the first issue), the order of addressing the issues could impact the values summarized in Table 2.

Table 1. Summary of Changes in HSR Interregional Daily Boardings

Alternative	Base Ridership	Due Diligence Ridership	Percent Change from Base
Altamont Pass	183,045	177,811	-2.9%
Pacheco Pass	191,628	183,335	-4.3%

Table 2. Relative Effects of Model Refinements on Interregional Ridership for Preferred HSR Alternative

	Change in Total Interregional Trips		Change in HSR Trips	Resulting HSR Mode Share
	Business/ Commute	Recreation/ Other		
Travel Model Runs for BACV EIR/S	*n/a*	*n/a*	*n/a*	6.6%
Transpose of Household Data	+7.2%	-32.8%	-14.9%	6.7%
Truncation of Sacramento Data	+0.2%	-1.9%	-0.3%	6.7%
Sacramento Income Estimates	+0.9%	+0.1%	+0.5%	6.7%
MTC Socioeconomic Data & HSR Network	+1.2%	+5%	+5.3%	7.2%
Auto Operating Costs	-0.1%	-0.4%	+4.5%	7.2%
Parking Costs	+0.0%	0.0%	+1.9%	7.3%
OVERALL	**+9.6%**	**-31.1%**	**-4.3%**	**7.3%**

Transpose of Input Household Data by Socioeconomic Strata

One of the main inputs to the HSR model is the number of households for each zone stratified by each logical combination of the following four strata:

- Household size (1, 2, 3, and 4+ persons)

- Income group (low, middle, and high)

- Number of workers (0, 1, and 2+)

- Number of autos owned (0, 1, and 2+)

Thus, for each zone, there are estimates of households for each of 99 logical strata required by the model. It was discovered that the order in which the data were input into the model was inconsistent with the order in which the computer program read the data. Consequently, the total number of households for each zone was correctly represented in the model but the distribution of households among the socioeconomic strata within zones was not processed correctly. Resolution of this issue had a net impact of decreasing total interregional trip-making (by all modes) and interregional trip-making on high speed rail, with a disproportionately large impact for trips beginning or ending in the Bay Area region. Furthermore, this transposition issue accounted for nearly the entire reduction in total trip making and HSR ridership.

Truncation of Sacramento Data

Data from a number of different Metropolitan Planning Organizations (MPOs) and other sources were combined to create the input socioeconomic data files for the HSR model. Household data for a number of zones in the Sacramento area were missed when the HSR

household dataset was created. Adding the missed households into the model increased the number of households for the Sacramento area input into the HSR model from 765,271 to 1,103,299. Resolution of this issue had a net impact of increasing total interregional trip-making (by all modes), but decreasing interregional trip-making on high speed rail.

Sacramento Region Income Estimates

Information provided with the original Sacramento household data indicated that income information for the forecast 2030 households was expressed in terms of year 2000 dollars. However, detailed review of the distribution of households by income group for Sacramento in comparison to other regions in the state suggested that this was not, in fact, the case. Detailed review of the most recent socioeconomic forecasts for Sacramento and consultation with Sacramento Area Council of Governments personnel confirmed that the incomes for the original data were, in fact, expressed in terms of 1990 dollars. The income data for the Sacramento region were adjusted using the relationship of the consumer price index data for 1990 and 2000. Addressing this issue increased the number of high income households and decreased the number of low income households in the Sacramento region and had a net impact of increasing total interregional trip-making (by all modes) and interregional trip-making on high speed rail.

Bay Area Socioeconomic Data

As with the Sacramento region, some of the socioeconomic distributions provided to CS for the Bay Area appeared to be inconsistent with the rest of the state. Marginal distributions of Bay Area households by income group and by number of autos owned were most different. An updated 2030 household dataset for the Bay Area was obtained from the MTC website. The marginal distributions for this dataset were much more in line with those for the rest of the state. The use of the updated MTC data had a net impact of increasing total interregional trip-making (by all modes) and interregional trip-making on high speed rail.

HSR Network and Operating Plans

Detailed checking of the high speed rail networks and operating plans used for the HSR forecasts for the Altamont and Pacheco alternatives uncovered a few relatively minor discrepancies in the coding of the networks. Rectifying the inconsistencies caused both positive and negative changes in forecast HSR ridership for the alternatives. The network adjustments produced essentially no changes in the total interregional trip-making (by all modes) and interregional trip-making on high speed rail.

Auto Operating Costs

Review of various reports and memoranda developed during the course of the project showed a range of assumed auto operating costs from 18 to 22 cents per mile (specified in

2005 dollars) per person. The original travel forecasts used 20 cents per mile per person. The various reports indicated that 22 cents per mile was a more reasonable value for future year forecasts. The specification of 22 cents per mile per person for auto costs had a net impact of decreasing total interregional trip-making (by all modes) while increasing interregional trip-making on high speed rail.

Parking Costs at HSR Stations and Airports

Questions regarding parking costs at HSR station and at airports had been raised after preparation of travel forecasts for the Altamont and Pacheco alternatives. It had been determined that the procedure used to forecast the parking costs tended to overestimate the costs for HSR stations and underestimate the costs for airports.

The updated travel forecasts performed for the due diligence testing used the parking costs at HSR stations and airports as indicated in Tables 2.11 and 2.12 of the *Levels-of-Service Assumptions and Forecast Alternatives Final Report*. The use of these parking costs for HSR stations and airports had essentially no effect on total interregional trip-making (by all modes) while increasing interregional trip-making on high speed rail.

■ Intraregional Model Refinement

The plan to rely on already adopted regional models was intended to reduce the development time and budget, eliminate unnecessary redundancy, and produce results comparable with normal regional model runs. Unfortunately, this plan resulted in delays to schedules and additional costs due to:

- Difficulties individual regions had in adopting their regional travel models;

- Odd results that necessitated a thorough checking and adjustment or correction of almost every aspect of the urban models; and

- Inconsistencies between HSR intraregional forecasts and forecasts using the regional models that resulted from ongoing corrections and adjustments to the region models used for the HSR forecasts.

Even though substantial efforts were made to make each of the intraregional models a viable tool for forecasting HSR ridership and revenue, there were still significant issues which impeded their use for some situations.

Southern California Intraregional Model for HSR

The design of the intraregional model for HSR in the Southern California (SCAG) region relied on several inputs from the SCAG regional model as well as the mode choice structure and parameters from the Santa Clara Valley Transportation Authority (SCVTA).

Transit (Non-HSR) Skimming

The SCAG intraregional model for HSR uses the output of the SCAG regional model skimming process for all TAZ-to-TAZ level of service values for each travel mode for both peak and offpeak conditions. Thus, the HSR model inherently accepts any assumptions made in the SCAG transit skimming process.

A generally accepted travel modeling practice is to ensure that the modeling process used for the base and future years is the same; only input socioeconomic data, transportation networks, and other exogenous inputs (such as parking costs) are changed. SCAG, unfortunately, was not able to run their previous model version on their future year network or their new model version on their base year network. This created an inherent inconsistency in the transit skims for the base and future years. Numerous updates and adjustments to the SCAG transit skimming process were received for both the base and future year. The updates and adjustments were evaluated and those that produced the most consistent results were incorporated into the version of the SCAG intraregional model used for HSR forecasts.

Even after the incorporation of the updates and adjustments, the new SCAG model version did not produce reasonable transit skims for the offpeak time period. In order to prevent additional schedule delays, the relationship between the peak and offpeak transit skims for the base validation year were applied to the future year peak-period transit skims.

Offpeak Future Year Skims=Peak Future Year Skims * Offpeak Base Year Skims/Peak Base Year Skims

This approach provided an estimate for the future year offpeak skims that effectively assumed that there would be no change in the relationships between offpeak and peak transit service in the SCAG region.

HSR Skimming

Several refinements were made to the HSR skimming process and input fare matrices to correct errors. A set of quality control heuristics was developed for each HSR skim to test for reasonableness. Specifically, HSR paths between TAZ pairs were not allowed if any of the following conditions were present:

1. The HSR path had HSR in-vehicle travel time of zero;

2. The trip required more than one transfer for drive access skims, or two transfers for walk access skims;

3. The time required to access HSR was greater than the time spent on HSR;

4. The total access distance was greater than 15 miles; and

5. The walk access or egress time was greater than one-half of the time spent on HSR.

Due to software problems, walk and drive access links could not be generated for the SCAG intraregional model. Instead, the walk and drive access links generated for the interregional travel model were used for the SCAG intraregional model for HSR. This implicitly allowed trips to use drive egress from HSR which was contrary to the original assumptions used for the model.

Trip Distribution

The trip distribution results from the most recent version of the SCAG regional model were used as input to the SCAG intraregional model for HSR.

Mode Choice Model Structure and Coefficients

The mode choice structure and coefficients from the SCVTA model were used. The non-home-based model for the SCAG intraregional model was modified to use the same nesting structure as home-based shop model. Parking cost at HSR stations was added to the fare in the HSR utility equations.

Calibration

After making the changes to the mode choice model structure and coefficients, the modal constants were recalibrated to reproduce observed base year ridership.

Bay Area Intraregional Model for HSR

The Bay Area Model for intraregional HSR is based on the SCVTA model which, in turn, is based on the MTC BAYCAST-90 model. The SCVTA mode choice model disaggregates the transit mode into submodes. The SCVTA model and, thus, the Bay Area Model for intraregional HSR, use trip tables by purpose from the MTC BAYCAST-90 model. Several issues were discovered with the implementation of the SCVTA model and the trip tables from the MTC BAYCAST-90 model. The issues were corrected to the extent possible as documented below.

Trip Distribution

The BAYCAST-90 trip distribution process produced questionable results for several large scale interchanges between TAZs on the peninsula and San Francisco. The questionable interchanges were adjusted to the extent possible considering the scope and budget for the project. Thus, the Bay Area intraregional model for HSR uses trip tables that should reflect an improvement over the trip distribution results from the BAYCAST-90 model. Other anomalies in the BAYCAST-90 trip distribution results were identified but schedule and budget concerns precluded detailed investigation and adjustment of the results. For example, recreational trips to and from the Walnut Creek area seem to be particularly high.

HSR Skimming

The transit path-building software produced numerous paths that were not particularly reasonable. As with the SCAG intraregional HSR model, a set of quality control heuristics

was developed for each HSR skim to test for reasonableness. Specifically, HSR paths between TAZ pairs were not allowed if any of the following conditions were present:

1. The HSR in-vehicle travel time was zero;

2. The trip required more than three transfers;

3. The time taken to access HSR was greater than the time spent on HSR; and

4. The total access distance was greater than 25 miles.

Mode Choice Model Structure and Coefficients

The BAYCAST-90 models only two transit modes: walk-to-transit and drive-to-transit. The SCVTA model disaggregates those modes into BART, commuter rail, light rail, express bus, and local bus for walk access to transit and for drive access to transit for the peak-period home-based work model. For all other trip purposes and times of day, the SCVTA mode choice model estimates trips for "drive-access to the best transit path."

The mode choice structure and coefficients from the SCVTA model were used. The nonhome-based model was modified to use the same nesting structure as home-based shop model. Parking cost at HSR stations was added to the fare in the HSR utility equations.

Mode Choice Input Files

Several issues with the sociodemographic inputs to the mode choice utility equations were uncovered. Specifically, some input files used in the mode choice models were created by the MTC trip generation procedure. Close examination of the files revealed that several of the values were outside of acceptable ranges (e.g., percentages summed to more than 100 percent). The questionable input files for the project received from MTC were replaced.

Calibration

After making the changes to the mode choice model structure and coefficients, the modal constants were recalibrated to reproduce observed base year transit ridership.

■ Station Access and Egress

A postprocessor was developed to assist in forecasting HSR station access, egress and parking duration. The intent of the postprocessor is to predict parking and multimodal access needs at HST stations. Essentially, the post-processor assigns each station to one of several prototype categories based on its location in the region, the density and urban form around the station, and the likely parking cost. Initial estimates of access and egress mode shares are then assigned to each station based on the category assigned to the station. Forecasts of each station's access and egress mode shares are then adjusted until the results sum to regional control totals derived from the HSR ridership and revenue model. The following sections describe each step of postprocessor development in more detail.

Station Access/Egress Prototypes

To estimate access/egress mode choice at HST stations, each station was assigned to a prototypical category. The central assumption is that stations sharing certain key characteristics will display similar access/egress patterns. Key characteristics that are associated with access/egress mode patterns are:

- Station area urban form/density;

- Parking costs surrounding the station area;

- Station region density; and

- Quality of available transit connections.

Six station prototypes were defined to represent different combinations of these characteristics. The categories and station assignments are listed in Table 3. Table 4 provides detail on the factors used to assign a station to a particular category, including the types of transit available at each station.

Representative Access/Egress Patterns for Airport and Rail Stations

CS gathered information on current access/egress patterns around existing airport and rail station areas. This information served as the basis for development of representative access/egress patterns associated with the station categories described above. The main sources and key findings from each are listed below:.

- The 2001 and 2002 MTC surveys of airport access/egress travel patterns. Key findings from these surveys include:[1]

  - Business travelers were about 1.5 times more likely to access the airport by drive and park than nonbusiness travelers;

  - Nonbusiness travelers were about 1.5 times more likely to access the airport by drive and drop-off than business travelers;

  - Business travelers were about twice as likely to access the airport by taxi or rental car than nonbusiness travelers;

  - Nonbusiness travelers were about twice as likely to access the airport by transit than business travelers;

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[1] Note that these relationships varied somewhat by airport.

Table 3. Station Categories and Assignments

Station Category	Stations Assigned to Category a	
"City Center" Highest density; highest parking cost; highest transit access, including rapid transit.	**Transbay** Oakland-7th Street	Oakland-12th Street **LA/Union Station**
"Urban Activity Center" High-density; high parking cost; rail (LRT or rapid transit) and extensive bus service.	**San Jose** Union City **San Diego** **Sacramento**	4th and King, SF **Millbrae/SFO** Oakland/Coliseum
"Developed Urban Area" Middle density; moderate parking cost; local and regional transit available.	Dublin/Pleasanton Warm Springs Shinn Palo Alto **Redwood City** **Anaheim**	**Irvine** Ontario **Norwalk** **Burbank** **Escondido**
"Outlying Downtown or Activity Center" Traditional grid-based downtown in low-density suburban area; moderate to low parking cost; local bus transit.	**Modesto Downtown** **Stockton** **Bakersfield** Fresno	**Riverside** Visalia **Merced**
"Exurban or Outlying Area – Rail Transit" Exurban or outlying; low-density station area; low parking cost/free parking; local transit and regional rail transit.	**Gilroy** Morgan hill Livermore I-680 (Bernal) Greenville/UPRR/Livermore	**Sylmar** **City of Industry** **Palmdale** Tracy – ACE
"Exurban or Outlying Area – No Rail Transit" Exurban or outlying; low-density station area; low parking cost/free parking; low or no transit service.	Briggsmore Tracy downtown Castle AFB **Temecula**	Livermore/I-580 Greenvile Road/I-580 **University City** East San Gabriel

Table 4. Station Assignment Detail

Station Name	Relative Density	Relative Parking Cost	Major Transit Types Available[a]	Deciding Factor
Transbay	Highest	Highest	HR, LRT, CR	HR connection, plus within or near highest density downtown.
Oakland-7th Street	Medium High	High	HR, AK	
Oakland-12th Street	High	High	HR, BRT	
LA/Union Station	Highest	Highest	HR, LRT, CR, BRT, AK	
San Jose	High	High	CR, LRT, AK	Major urban activity center, with rail transit connection.
Union City	High	Medium High	HR, CR	
San Diego	High	Highest	LRT, CR, AK	
Sacramento	High	High	LRT, AK	
4th and King, SF	High	High	LRT, CR	
Millbrae/SFO	Medium High	High	HR, CR	
Oakland/Coliseum	Medium High	Medium High	HR, AK	
Dublin/Pleasanton	Medium High	Medium Low	HR	Within major metropolitan area, but lower density and parking cost in station area.
Warm Springs	Medium High	Medium Low	HR	
Shinn	Medium High	Medium Low	Future HR, CR	
Palo Alto	Medium High	Medium	CR, BRT	
Redwood City	Medium High	Medium	CR, BRT	
Anaheim	Medium High	Medium Low	CR, AK	
Irvine	Medium High	Medium Low	CR, AK	
Ontario	Medium High	Medium Low	CR, AK	
Norwalk	Medium High	Medium Low	CR, AK	
Burbank	Medium High	Medium	CR, AK	
Escondido	Medium High	Medium Low	LRT, BRT	
Modesto Downtown	Medium Low	Low	Express Bus, AK	Outside of major metropolitan area (rail transit may or may not be available).
Stockton	Medium	Low	AK, CR	
Bakersfield	Medium	Low	AK	
Fresno	Medium	Low	AK	
Riverside	Medium	Low	CR, AK	
Visalia	Low	Low	None	
Merced	Medium Low	Low	AK	
Gilroy	Low	Low	CR	Exurban or outlying area; passenger rail connection available.
Morgan Hill	Low	Low	CR	
Livermore Downtown	Medium Low	Low	CR	
I-680 (Bernal)	Low	Low	HR, CR	
Greenville/UPRR/Livermore	Low	Low	CR	
Sylmar	Low	Low	CR	
City of Industry	Low	Low	CR	
Palmdale	Low	Low	CR	
Tracy – ACE	Low	Low	CR	

Table 4. Station Assignment Detail (continued)

Station Name	Relative Density	Relative Parking Cost	Major Transit Types Available a	Deciding Factor
Briggsmore	Low	Low	None or local bus	Exurban or outlying area; no rail transit available.
Tracy Downtown	Low	Low	None or local bus	
Castle AFB	Low	Low	None or local bus	
Temecula	Low	Low	None or local bus	
Livermore/I-580	Low	Low	None or local bus	
Greenville Road/I-580	Low	Low	None or local bus	
University City	Low	Low	None or local bus	
East San Gabriel	Low	Low	None or local bus	

a HR (Heavy Rail); LRT (Light Rail); CR (Commuter Rail); BRT (Bus Rapid Transit); AK (Amtrak).

– Nonbusiness travelers were more than two times as likely as business travelers to be picked up in a personal vehicle; and

– Whether the individual was a Bay Area resident had a stronger impact overall on mode choice than did their trip purpose. Visitors were more likely to be dropped off and picked up, while residents were more likely to drive and park.

In addition, the average access/egress mode shares for the three Bay Area airports were considered (Table 5).

• Access/egress results by station from the *Amtrak Capitol Corridor Satisfaction Study* conducted by Corey, Canapary & Galanis in 2007. Key findings from this survey include:

– Stations in dense urban areas (e.g., Oakland Jack London Square; Sacramento) had the lowest percentage of drive and park and drive and drop-off modes and the highest percentage of transit and other modes. Conversely, stations in low-density or outlying areas (e.g., Auburn, Rocklin, Roseville) had the highest share of drive modes.

– Taxi was used very infrequently for all stations.

– Rental car was not listed as an access or egress mode.

– Walk/bike were used for a very significant share of access and egress trips, especially in areas such as Berkeley, Davis, Oakland Jack London Square, and Sacramento. Walking was used twice as frequently for access trips compared to egress trips.

– Public transit and shuttles accounted for about 14 percent of access trips and 19 percent of egress trips.

Table 5. Approximate Average Access/Egress Modesplits for Bay Area Airports

	Metropolitan Transportation Commission Airports					
	Drive and Park	Drive and Drop /Pickup	Rental	Taxi	Transit	Other/ unknown
Access (Average)	~25%	~25%	20%	20%	10%	0
Egress (Average)	15%	40%	15%	15%	5%	15% (unknown)

Note: Values rounded to the nearest five percent, therefore, they do not sum to 100 percent. Values represent averages among the three San Francisco Bay area airports for 2002 (in San Francisco, San Jose, and Oakland). For access trips, drive and drop, and drive and park mode shares were not differentiated in the survey (all were considered "personal vehicle" trips). The mode share was estimated using the average response to questions regarding the disposition of personal vehicles.

Source: 2002 Metropolitan Transportation Commission Survey of airport access/egress travel patterns. http://www.mtc.ca.gov/maps_and_data/datamart/survey/airpass1.htm.

In addition, the Capitol Corridor results (Table 6) were considered when estimating approximate maximum and minimum mode share values reflecting the range of station types.

- TRB Transportation Research Circular E-C026, "Evaluating the accessibility of U.S. Airports – Results from the American Travel Survey. Personal Travel: the Long and Short of it," 1999. This source analyzed noncommute trips of 100 miles or more made at airports throughout the United States. Key findings from this survey include:

  - Access to Airports – Drive and park is the dominant access mode overall, but its share varies considerably by airport. Airports around cities with very high parking costs (e.g., New York City airports) showed very high use of shuttles and taxis (as much as 60 percent of access trips) and less use of driving/parking at the airport.

  - Access to Airports – Public transit access mode share varied little between cities, ranging from 0 to a little over 10 percent. Washington National airport had the highest use of rail transit as the access mode (10 percent).

  - Access to Airports – Business travelers were more likely to drive and park or take a taxi when accessing the airport than nonbusiness travelers.

  - Access to Airports – Nonbusiness travelers (leisure, etc.) were more likely to be dropped off or to take public transit than business travelers.

Table 6. Systemwide Access/Egress Share for Capitol Corridor Stations

	Drive and Park	Drive and Drop	Rental	Taxi	Transit	Walk/Bike Other
Access	20-65%	15-45%	0%	0-2%	2-40%	2-45%
Egress	10-70%	10-40%	0%	1-6%	5-45%	10-65%

Note: The Richmond Station was anomalous, with 64 % of access/egress trips by passenger rail, and was not included. Drive and park mode includes carpools. Transit mode includes rail transit, Amtrak thruway bus, bus transit, shuttles, and Amtrak long-distance train.

Source: Access/egress results by station from the Amtrak Capitol Corridor Satisfaction Study conducted by Corey, Canapary & Galanis in 2007.

– Egress from Airports – Picked up by private vehicle was the dominant egress mode, followed closely by rental car. However, egress mode shares also varied significantly by airport. For example, taxi and shuttle were used for more than 50 percent of egress trips from New York City airports compared to 25 percent for all cities. Rental car was used for less than 10 percent of egress trips from New York City airports, as compared to more than 35 percent overall. Again, this probably reflects the high cost of parking in New York City.

– Egress from Airports – Public transit egress mode share varied little between cities, ranging from 0 to a little over 10 percent.

In addition, the range of access/egress results from the airports included in the analysis (Table 7) were considered.

Table 7. Range of Access/Egress Modesplits for Selected U.S. Airports

	Drive and Park/Unpark	Drive and Pickup/Dropoff	Rental	Taxi	Transit	Other
Access (1995 ATS)	20-65%	15-40%	0	5-60%	0-10%	0/NA
Egress	0	20-45%	5-50%	10-55%	0-10%	0/NA

Note: Values over five rounded to the nearest fifth. Values represent a range of airports, including those in and around Philadelphia, Boston, New York, Chicago, Washington, San Francisco, Los Angeles, Atlanta, and others.

Source: TRB Transportation Research Circular E-C026, "Evaluating the accessibility of U.S. Airports – Results from the American Travel Survey. Personal Travel: the Long and Short of it." 1999.

- The *1995 American Travel Survey*[2] includes analysis of access/egress patterns for noncommute trips of 100 miles or more made throughout the United States. Some key findings from this effort include:

  – About 40 percent of long-distance train travelers accessed the station by driving and parking. Another 32 percent were dropped off; 15 percent used public transit (bus or subway); 10 percent took taxi; and the remaining 3 percent walked or took another mode. None rented a vehicle.

  – About 49 percent of long-distance train riders were picked up at the station; 16 percent used public transit; 23 percent took taxi from the station; 6 percent walked from the station; and only a small proportion rented a vehicle.

- *BART Station Profile Study*, August 1999. Key findings from this study include:

  – Walk and transit access and egress are very high around high-density downtown stations (San Francisco, Oakland).

  – Similarly to the Amtrak Capitol Corridor data, walk mode share is significantly higher for egress trips.

General Principles for HSR Station Access and Egress

Due to the varying nature of the sources listed above, no one source was sufficient to define the likely access/egress patterns at any given HSR station type, particularly because of the need to meet the modal categories assigned by the HSR model. The HSR model results are expressed in terms of drive and park; drive and drop-off; taxi; transit; and other. None of the sources listed above define access/egress mode shares in the same categories. For example, rental car was not included in the list of modes chosen to access Amtrak Capitol Corridor stations. Walk/bike was not listed as an option for accessing airports.

Given these discrepancies, it was necessary to apply judgment when using the research results to estimate HSR access/egress mode shares. Principally, the sources were used to establish upper and lower bounds for mode shares and to estimate relationships between mode shares for different trip purposes. Several general principles were derived from the research which guided the estimation of the shares:

- Business Trips:

  – Drive/park mode share is about 1.5 times drive/drop-off mode share;

  – Taxi is used more than rental car in areas with high parking costs; otherwise rental car is used more than taxi;

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[2] http://www.bts.gov/publications/1995_american_travel_survey/us_profile/entire.pdf.

- – Rental car and taxi are used infrequently overall, but more frequently for business versus nonbusiness trips; and

- – Automobile mode share rises as station area density decreases.

- Commute Trips:

  - – Drive/park mode share is about 1.5 times drive/drop-off mode share. However, in areas with high parking costs, drive and park mode share will be approximately equal to drive and drop-off mode share;

  - – Transit/shuttles and walk/bike/other will be used more frequently than they are for business/other trip purposes;

  - – Transit/shuttles will be used more frequently than walking;

  - – Rental car and taxi will be used infrequently; and

  - – Automobile mode share rises as station area density decreases.

- Other Trips:

  - – Drive/drop-off mode share is about 1.5 times drive/park mode share (the reverse of business and commute trip purposes);

  - – Transit/shuttle and walk/bike/other will be used less frequently than for commute trip types but more frequently than for business trips;

  - – Rental car and taxi will be used infrequently; and

  - – Automobile mode share rises as station area density decreases.

Differences Between Access and Egress Trips

The main differences between access and egress mode shares observed in the sources above is in the share of trips by the "drive and pickup/drop-off" mode versus the "drive and park/unpark" mode.

Drive and park have a greater share for access trips, and drive and pickup/drop-off and rental car had a greater share for egress trips. These apparent differences may be due in part to imbalanced sampling of trip ends. For example, in the analysis of American Travel Survey Data, "drive-parked vehicle" was not listed as a possible egress mode. This is because the survey focused on only one trip end; interviewees were asked to report their mode of egress only from the destination airport/train station. They were not asked to report the mode of egress for the return egress trip from the home airport/train station. If all trip ends were sampled, it would be expected that access and egress patterns would be approximately similar.

Table 8 presents composite mode shares that represent the expected average mode shares for both access and egress trips. These values reflect the principles described previously, and are used as a starting point in the access/egress post-processor.

Table 8. Estimated Access/Egress Mode Share by Station Type and Trip Purpose

Station Category	Drive Parked Vehicle	Pickup / Dropoff	Rental Car	Taxi	Transit/ Shuttle	Walk/ Bike/Other	Sum
Business Trips							
1	25%	15%	10%	25%	15%	10%	100%
2	35%	20%	15%	15%	10%	5%	100%
3	40%	25%	15%	10%	5%	5%	100%
4	50%	35%	5%	5%	4%	1%	100%
5	55%	35%	3%	3%	3%	1%	100%
6	60%	35%	1%	2%	1%	1%	100%
Commute Trips							
1	25%	18%	1%	1%	30%	25%	100%
2	34%	24%	1%	1%	25%	15%	100%
3	45%	30%	1%	1%	15%	8%	100%
4	50%	35%	1%	1%	9%	4%	100%
5	55%	40%	1%	1%	2%	1%	100%
6	60%	36%	1%	1%	1%	1%	100%
Other Trips							
1	20%	30%	10%	5%	20%	15%	100%
2	25%	35%	10%	5%	15%	10%	100%
3	30%	45%	10%	5%	5%	5%	100%
4	35%	50%	10%	1%	3%	1%	100%
5	40%	55%	1%	1%	2%	1%	100%
6	41%	55%	1%	1%	1%	1%	100%

Forecasting Access/Egress Patterns for Individual Stations

The mode shares displayed in Table 8 are applied to station boarding totals by trip purpose from the HSR model to provide an initial forecast of the number of access and egress trips by mode.

These initial forecasts then undergo an iterative growth-factor adjustment process until they sum to statewide control totals. The iterative adjustment is necessary to assure consistency between individual station area estimates and the output of the HST model. Reasonable matching of station-level estimates and statewide totals is achieved using an iterative growth factoring procedure.

The iterative adjustment process produces final values for the number of daily average access and egress trips by mode for each station. The following adjustments are then performed to convert person-trips to vehicle-trips and to reflect the impact of trip duration on vehicle accumulation for parked vehicles.

- **Drive and Park Trips –** This value is adjusted to provide a better estimate of multi-day parking demand associated with drive and park trips. The initial value is divided by average party size, and then adjusted to account for varying trip duration.

- **Drive and Drop-Off/Pick-up Trips –** These trips are divided by average party size to determine the number of average daily auto drop-off trips.

- **Rental Car Trips –** These trips are divided by average party size to determine the number of average daily rental car transactions.

- **Taxi Trips –** These trips are divided by average party size to determine the number of average daily taxi transactions.

- **Transit/Shuttle Bus, and Walk/Bike/Other Trips –** No adjustment are made.

Table 9 shows the average party size and trip duration (number of nights) by trip purpose derived from the stated-preference surveys.

The postprocessor is intended to produce a planning-level estimate of parking needs. The estimate should be considered an upper bound on actual needs, which may vary significantly from the estimate. In addition, it should be noted that station-area development decisions and broader policy decisions will have a significant impact on demand for parking, transit, nonmotorized modes, and rental car (e.g., carsharing). For example, the Amtrak Capitol Corridor policy of allowing bicycles on-board has contributed to significant use of bicycles for station access/egress.

Table 9. Average Party Size and Number of Nights Duration by Trip Purpose

Type	Average Party Size
Business	1.5
Commute	1.2
Other	2.5
Trip Duration (Number of Nights Away)	
0	27%
1	16%
2-3	33%
4-6	16%
7+	8%

Note: Intraregional trips will be assumed to have a duration of 0 nights.

■ Automated Model Output

CS worked with the PMT to define a standard output spreadsheet to report and compare model results across scenarios. CS developed scripts within the CUBE software framework that produce the input data for the spreadsheets. The summary spreadsheets include the following items for each scenario:

- Ridership and revenue for HSR as well as ridership and modal share for competing modes;

- Daily passenger volumes for each HSR segment;

- Boardings at each HSR station;

- Induced travel, destination diversions, and modal shifts to HSR;

- Region to region travel by mode and purpose;

- Access and egress to HSR mode splits;

- Available access modes for each station; and

- Station to station level of service by time period and mode.

CS prepared summary sheets for each set of forecasts prepared for the PMT.

■ Forecasts for Initial HSR Phase

Establish Parameters of Phasing and Fare Test

CS worked with the PMT to develop and evaluate the ridership for a base scenario for an initial HSR phase between Anaheim and the Bay Area. The initial HSR alignment is based on the base Pacheco (P1) scenario, with service from Anaheim to San Francisco, eliminating service between Merced and Sacramento, Los Angeles Union Station and San Diego, and Anaheim and Irvine. The PMT developed Phase 1 operating plan based on a review of the P1 operating plan and ridership forecasts prepared for the BACV EIR/S. Tables 10 and 11 summarize the peak and offpeak operating plans for Phase 1.

Base Model Run for Bay Area to Anaheim Alignment

CS ran the Statewide Model for High-Speed Rail for the Phase 1 scenario using the following assumptions:

- HSR fares developed and used in the BACV EIR/S; and

- Network, cost, and operating policies for all competing modes (air, conventional rail, and auto) as used in the BACV EIR/S.

Table 12 compares the daily boardings forecast for the Phase 1 operating plan alongside the boardings forecast for the Pacheco Base (P1) scenario.

Table 10. Initial P1-Phase1-B Operating Plan
Peak

	Train patterns for 6 peak hours, one-way							
Pattern#	1nb	2	7nb	9nb	10nb	13nb	M1	M2
Frequency of service (mins)	120	60	120	30	30	120	40	40
SFD	Φ	Φ	Φ	Φ	Φ	Φ	Φ	
MLB	|	|	σ	σ	|	|	σ	
RWC	σ	|	σ	|	σ	σ	σ	
SJO	σ	σ	σ	σ	σ	σ	σ	
MHL	|	|	|	|	|	|	|	
GRY	σ	|	σ	|	σ	|	σ	
MOD	|	|	|	|	|	|	|	
MER	|	|	|	|	|	|	Φ	Φ
FRS	|	|	σ	σ	|	|		σ
BAK	|	|	σ	σ	|	|		σ
PLM	|	|	|	|	σ	σ		σ
SYL	|	|	|	σ	|	σ		σ
BUR	|	|	|	|	σ	σ		σ
LAU	σ	Φ						
NWK	σ		σ			σ		σ
ANA	Φ		Φ			Φ		Φ
# of trains	3	6	3	12	12	3	9	9

Φ   End/beginning of run.
Ơ   Intermediate stop.
\| Run through – no stop.

Table 11. Initial P1-Phase1-B Operating Plan
Offpeak

	Train patterns for 10 off-peak hours, one-way							
Pattern#	1nb	4nb	7nb	9nb	10nb		M1	M2
Frequency of service (mins)	120	120	120	30	30		75	75
SFD	Φ	Φ	Φ	Φ	Φ		Φ	
MLB	|	σ	σ	σ	|		σ	
RWC	σ	σ	σ	|	σ		σ	
SJO	σ	σ	σ	σ	σ		σ	
MHL	|	|	|	|	|		|	
GRY	σ	σ	σ	|	σ		σ	
MER	|	|	|	|	|		Φ	Φ
FRS	|	σ	σ	σ	|			σ
BAK	|	σ	σ	σ	|			σ
PLM	|	σ	|	|	σ			σ
SYL	|	σ	|	σ	|			σ
BUR	|	σ	|	|	σ			σ
LAU	σ	σ	σ	Φ	Φ			
NWK/FUL	σ	σ	σ					σ
ANA	Φ	Φ	Φ					Φ
trains	5	5	5	20	20	0	8	8

Φ   End/beginning of run.
Ơ   Intermediate stop.
\| Run through – no stop.

Table 12. Station Boardings for Full System and Phase I

HSR Station	Full System (P1)	Phase 1
San Francisco (Transbay)	26,540	32,889
Millbrae	2,936	2,845
Redwood City	4,603	4,599
San Jose	11,789	10,485
Morgan Hill	955	n/a
Gilroy	4,816	6,072
Sacramento	18,699	n/a
Stockton	5,064	n/a
Modesto	3,671	n/a
Merced	1,558	7,370
Fresno	6,841	6,323
Bakersfield	8,672	7,562
Palmdale	19,639	17,065
Sylmar	12,990	7,814
Burbank	7,403	4,217
Los Angeles Union Station	31,432	17,197
Norwalk	3,456	5,613
Anaheim	12,535	29,034
Irvine	5,671	n/a
City of Industry	4,313	n/a
Ontario	4,893	n/a
Riverside	9,116	n/a
Temecula	5,058	n/a
Escondido	8,575	n/a
University City	5,558	n/a
San Diego	18,441	n/a
Subtotal (common stations)	*155,209*	*159,084*
Total	**269,732**	**159,084**

Note: n/a indicates an HSR station that is not present in Phase I

Fare and Parking Cost Sensitivity Testing

The high-speed rail fares used for the BACV EIR/S and initial Phase 1 forecasts were based on fixed fare components plus variable per-mile fare components. Separate fixed and variable fares were established for the intraregional and interregional trips.

As a part of each fare sensitivity run, CS documented the assumptions for each station to station fare and helped the PMT prepare a spreadsheet aligning the HSR fare to competing modes. The spreadsheet facilitated the modal comparison to make sure the fares used in the fare sensitivity testing were reasonable and suitable to be tested in full-scale model runs.

As mentioned above, an initial boarding fee plus a distance-based per-mile charge comprise HSR fares. These components can be different for intra- and interregional HSR stations pairs. The following list documents the changes made between P1-Phase1-B and each of the three fare sensitivity tests performed:

- Fare Sensitivity Test 1 (FS1) – All HSR fare components increased by 33 percent;

- Fare Sensitivity Test 2 (FS2) – All HSR fare componentss increased by 66 percent;

- Fare Sensitivity Test 3 (FS3):

    – Boarding and per-mile portions for interregional station pairs increased by 66 percent;

    – Initial boarding fare for intraregional station pairs increased to $25; and

    – Distance-based fare for intraregional station pairs increased by 66 percent to $0.10 per mile.

- Fare Sensitivity Test 4 (FS4):

    – Same HSR boarding and distance fares as for initial Phase 1 and full system runs;

    – HSR station parking costs increased to $32 at San Francisco; $18 at San Jose, Burbank, Los Angeles Union Station, and Anaheim; and $12 at all other Phase 1 stations.

HSR Fare and Parking Cost Sensitivity Results

Tables 13 through 16 summarize the ridership and revenue by market for each of the three fare sensitivity runs compared to the Phase 1 base run. The ridership results from FS1 through FS4 shown in Table 13 are as expected: As HSR fares or station parking costs are increased, HSR ridership decreases. The mode shares shown in Table 14 reflect the results summarized in Table 13. Note that within region mode shares are very low since the total within region trips include trips on interchanges not logically served by HSR. Thus, the changes in within region mode shares between FS2 and FS3 are less than 0.05 percent.

Table 15 shows the HSR revenue accruing due to HSR fares from the various alternatives. As can be seen by comparing Tables 13 and 15, relatively similar revenues accrue to HSR due to the higher fares even though the ridership resulting from the higher fares decreases. Table 16 shows the resulting average fare paid by each of the various markets for the different fare and parking cost scenarios. Note that the information shown in Tables 15 and 16 are based strictly on HSR fares; average parking costs paid at HSR are in addition to the average fares. Parking revenue is not included in either table.

Table 13. Annual HSR Ridership (Millions of Riders)

	Market	Phase 1 Base Run	Phase 1 Fare Sensitivity Runs			
			FS1	FS2	FS3	FS4
1	LA Basin-Sacramento	1.8	1.5	1.2	1.2	1.8
2	LA Basin-San Diego	0.1	0.1	0.1	0.1	0.1
3	LA Basin-Bay Area	10.6	8.7	6.8	6.9	10.5
4	Sacramento-Bay Area	0.0	0.0	0.0	0.0	0.0
5	San Diego-Sacramento	0.0	0.0	0.0	0.0	0.0
6	San Diego-Bay Area	3.2	2.5	1.8	1.8	3.1
7	Bay Area-San Joaquin Valley	7.4	6.4	5.4	5.4	7.3
8	San Joaquin Valley-LA Basin	8.3	7.0	5.9	5.4	8.2
9	Sacramento-San Joaquin Valley	0.6	0.5	0.5	0.5	0.6
10	San Diego-San Joaquin Valley	0.1	0.1	0.1	0.1	0.1
11	Within Bay Area Peninsula	4.8	3.9	3.6	2.4	4.0
12	Within North LA Basin	4.8	4.1	3.6	2.0	4.8
14	Within South LA Basin	1.3	1.2	1.1	0.6	0.4
15	North LA-South LA	3.9	3.5	3.2	1.9	2.6
18	Within San Diego Region	0.0	0.0	0.0	0.0	0.0
19	Within San Joaquin Valley	0.9	0.7	0.5	0.5	0.9
20	Other	6.4	5.4	4.5	4.2	6.3
	Total	**54.2**	**45.6**	**38.2**	**32.9**	**50.6**
	Within Entire LA Basin	*9.9*	*8.9*	*7.9*	*4.5*	*7.7*
	Within Entire MTC	*4.8*	*3.9*	*3.6*	*2.4*	*4.0*
	Total Between Regions	***39.5***	***32.8***	***26.7***	***26.0***	***38.9***

Table 14. HSR Mode Shares

	Market	Phase 1 Base Run	Phase 1 Fare Sensitivity Runs			
			FS1	FS2	FS3	FS4
1	LA Basin-Sacramento	25.0%	20.0%	16.0%	16.0%	24%
2	LA Basin-San Diego	0.0%	0.0%	0.0%	0.0%	0%
3	LA Basin-Bay Area	51.0%	42.0%	33.0%	33.0%	51%
4	Sacramento-Bay Area	0.0%	0.0%	0.0%	0.0%	0%
5	San Diego-Sacramento	1.0%	0.0%	0.0%	0.0%	1%
6	San Diego-Bay Area	35.0%	28.0%	21.0%	21.0%	34%
7	Bay Area-San Joaquin Valley	10.0%	9.0%	7.0%	8.0%	10%
8	San Joaquin Valley-LA Basin	12.0%	10.0%	8.0%	8.0%	11%
9	Sacramento-San Joaquin Valley	3.0%	2.0%	2.0%	2.0%	3%
10	San Diego-San Joaquin Valley	24.0%	22.0%	21.0%	21.0%	24%
11	Within Bay Area Peninsula	0.1%	0.1%	0.0%	0.0%	0.1%
12	Within North LA Basin	0.1%	0.0%	0.0%	0.0%	0.1%
14	Within South LA Basin	0.0%	0.0%	0.0%	0.0%	0.0%
15	North LA-South LA	0.1%	0.1%	0.1%	0.1%	0.1%
18	Within San Diego Region	0.0%	0.0%	0.0%	0.0%	0.0%
19	Within San Joaquin Valley	0.0%	0.0%	0.0%	0.0%	0.0%
20	Other	0.1%	0.1%	0.1%	0.1%	0.1%
	Total	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**
	Within Entire LA Basin	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*
	Within Entire MTC	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*
	Total Between Regions	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***

Table 15. Annual HSR Revenue (Millions of 2005 Dollars)

Market		Phase 1 Base Run	Phase 1 Fare Sensitivity Runs			
			FS1	FS2	FS3	FS4
1	LA Basin-Sacramento	$104	$112	$110	$112	$102
2	LA Basin-San Diego	$1	$2	$2	$3	$1
3	LA Basin-Bay Area	$586	$641	$632	$640	$581
4	Sacramento-Bay Area	$0	$0	$0	$0	$0
5	San Diego-Sacramento	$2	$1	$1	$1	$1
6	San Diego-Bay Area	$181	$190	$176	$176	$177
7	Bay Area-San Joaquin Valley	$286	$327	$343	$349	$282
8	San Joaquin Valley-LA Basin	$291	$335	$355	$356	$286
9	Sacramento-San Joaquin Valley	$26	$32	$33	$33	$26
10	San Diego-San Joaquin Valley	$3	$3	$4	$4	$3
11	Within Bay Area Peninsula	$45	$61	$56	$68	$55
12	Within North LA Basin	$48	$55	$59	$61	$46
14	Within South LA Basin	$11	$14	$16	$16	$11
15	North LA-South LA	$36	$43	$49	$54	$20
18	Within San Diego Region	–	–	–	–	-
19	Within San Joaquin Valley	$24	$24	$23	$23	$23
20	Other	$256	$286	$292	$300	$253
	Total	**$1,900**	**$2,125**	**$2,152**	**$2,196**	**$1,869**
	Within Entire LA Basin	*$95*	*$112*	*$123*	*$131*	*$77*
	Within Entire MTC	*$45*	*$61*	*$56*	*$68*	*55$*
	Total Between Regions	*$1,760*	*$1,952*	*$1,972*	*$1,997*	*$1,737*

Note: Station parking revenue not included in figures shown in the table.

Table 16. Average HSR Fares (2005 Dollars)

Market		Phase 1 Base Run	Phase 1 Fare Sensitivity Runs			
			FS1	FS2	FS3	FS4
1	LA Basin-Sacramento	$56	$75	$94	$94	$56
2	LA Basin-San Diego	$12	$16	$20	$34	$12
3	LA Basin-Bay Area	$55	$74	$93	$93	$55
4	Sacramento-Bay Area	$10	$14	$17	$28	$10
5	San Diego-Sacramento	$57	$81	$98	$102	$59
6	San Diego-Bay Area	$57	$76	$96	$96	$57
7	Bay Area-San Joaquin Valley	$39	$51	$64	$64	$39
8	San Joaquin Valley-LA Basin	$35	$48	$60	$65	$35
9	Sacramento-San Joaquin Valley	$44	$59	$74	$74	$44
10	San Diego-San Joaquin Valley	$38	$52	$62	$62	$39
11	Within Bay Area Peninsula	$9	$16	$16	$29	$14
12	Within North LA Basin	$10	$13	$17	$30	$10
14	Within South LA Basin	$9	$11	$14	$27	$9
15	North LA-South LA	$9	$12	$15	$29	$9
18	Within San Diego Region					
19	Within San Joaquin Valley	$26	$36	$48	$48	$26
20	Other	$40	$52	$64	$72	$40
	Total					
	Within Entire LA Basin	*$10*	*$13*	*$16*	*$29*	*$10*
	Within Entire MTC	*$9*	*$16*	*$16*	*$29*	*$14*
	Total Between Regions	*$45*	*$59*	*$74*	*$ 77*	*$45*

Table 17 compares the average daily station boardings for the different finance plan runs with the P1-Phase1-B base run. Station boardings by alternative reflect the same patterns demonstrated by the HSR ridership in Table 4.

Access mode trips and shares for the fare sensitivity scenarios are compared with the base in Table 18. Egress trip patterns are identical to access trip patterns at each station.

Comparison of average daily parking accumulation, daily drop-offs, daily rental car transactions, and daily taxi transactions of the fare sensitivity scenarios with the base are given the in Table 19.

Table 17. Average Daily Boardings at HSR Stations

	Phase 1	FS1	FS2	FS3	FS4
San Francisco (Transbay)	32,889	27,418	22,700	21,045	31,667
Millbrae	2,845	2,282	1,984	1,448	2,502
Redwood City	4,599	3,737	3,158	2,555	4,269
San Jose	10,485	8,471	7,147	6,104	9,593
Gilroy	6,072	5,225	4,487	3,672	5,762
Merced	7,370	6,187	5,240	5,265	7,279
Fresno	6,323	5,311	4,390	4,397	6,228
Bakersfield	7,562	6,243	5,112	5,152	7,397
Palmdale	17,065	14,690	12,494	8,672	15,028
Sylmar	7,814	6,302	5,141	4,142	7,208
Burbank	4,217	3,524	2,903	1,876	3,610
Los Angeles Union Station	17,197	14,948	12,829	8,326	14,490
Norwalk	5,613	4,811	4,088	3,151	5,189
Anaheim	29,034	25,045	21,225	19,010	27,442
Total	**159,084**	**134,192**	**112,896**	**94,814**	**147,665**

Table 18. HSR Station Access and Egress

Mode	Phase 1	FS1	FS2	FS3	FS4
Total Trips					
Drop Off	36,907	30,682	25,218	21,210	34,233
Park	48,262	40,890	34,438	29,050	44,918
Rental Car	11,807	9,968	8,397	7,067	10,992
Taxi	12,429	10,670	9,201	7,672	11,539
Transit	25,306	21,401	18,179	15,244	23,449
Walk	24,373	20,581	17,463	14,571	22,533
Total	**159,084**	**134,192**	**112,896**	**94,814**	**147,665**
Percent of Total Access					
Drop Off	23%	23%	22%	22%	23%
Park	30%	30%	31%	31%	30%
Rental Car	7%	7%	7%	7%	7%
Taxi	8%	8%	8%	8%	8%
Transit	16%	16%	16%	16%	16%
Walk	15%	15%	15%	15%	15%
Total	**100%**	**100%**	**100%**	**100%**	**100%**
Difference from Base					
Drop Off		-0.3%	-0.9%	-0.8%	0.1%
Park		0.1%	0.2%	0.3%	-0.3%
Rental Car		0.0%	0.0%	0.0%	-0.3%
Taxi		0.1%	0.3%	0.3%	0.0%
Transit		0.0%	0.2%	0.2%	0.2%
Walk		0.0%	0.1%	0.0%	0.4%

Table 19. HSR Station Parking Accumulation, Drop Offs, Rental Car, and Taxi Transactions

Mode	Phase 1	FS1	FS2	FS3	FS4
Total Trips					
Average Daily Parking Accumulation	75,310	64,017	53,873	49,709	72,706
Average Daily Auto Drop-Offs	19,761	16,587	13,826	11,412	18,191
Average Daily Rental Car Transactions	6,732	5,737	4,896	4,087	6,247
Average Daily Taxi Transactions	7,810	6,752	5,870	4,930	7,270
Difference from Base					
Average Daily Parking Accumulation		-15.0%	-28.5%	-34.0%	-3.5%
Average Daily Auto Drop-Offs		-16.1%	-30.0%	-42.2%	-7.9%
Average Daily Rental Car Transactions		-14.8%	-27.3%	-39.3%	-7.2%
Average Daily Taxi Transactions		-13.6%	-24.8%	-36.9%	-6.9%

■ Ridership and Revenue Modeling for Segment Phasing

Segment Phasing Scenarios and Operating Plans

As directed by the PMT, CS conducted model runs for two network segments using operating plans prepared by the PMT and the same fare structure and assumptions used in the Phase 1 scenario. The network segments that were tested were:

- San Francisco to San Jose (via Pacheco); and

- Merced to Bakersfield.

The operating plans for both phasing runs are shown below in Tables 20 through 23.

Table 20. Operating Plan for San Jose to San Francisco Segment
Peak

	Train patterns at 6 peak hours, one-way							
Pattern#	1	2	7					
Frequency of service (mins)	0	30	15					
	Run times from start in minutes							
SFD	0	0	0					
MLB					13					
RWC	20			23					
SJO	32	30	36					
MHL								
GRY								
MER								
FRS								
BAK								
PLM								
SYL								
BUR								
LAU								
NWK								
ANA								
# of trains	0	12	24	0	0	0	0	0

11   Time from start of run to departure from station, including dwell.

| Run through – no stop.

Table 21. Operating Plan for San Jose to San Francisco Segment
Offpeak

	Train patterns for 10 off-peak hours, one-way							
Pattern#	1	4		9	10		M1	M2
Frequency of service (mins)	40	40						
	Run times from start in minutes							
SFD	0	0						
MLB			13						
RWC	20	23						
SJO	32	36						
MHL								
GRY								
MER								
FRS								
BAK								
PLM								
SYL								
BUR								
LAU								
NWK								
ANA								
# of trains	15	15	0	0	0	0	0	0

11   Time from start of run to departure from station, including dwell.

| Run through – no stop.

Table 22. Operating Plan for Merced to Bakersfield Segment
Peak

		Train patterns at 6 peak hours, one-way						
Pattern#	**1**	**2**	**7**	**9**	**10**	**13**	**M1**	**M2**
Frequency of service (mins)	30	0						
	Run times from start in minutes							
SFD								
MLB								
RWC								
SJO								
MHL								
GRY								
MER	0	0	90 seconds (1 minute) faster to Bakersfield than in full v1b					
FRS	21			due to removal of dwell time in Bakersfield				
BAK	58	53						
PLM			5 minutes estimated by NB as saved by through Fresno trains					
SYL			based on trains stopping and through Gilroy in full v1b					
BUR								
LAU								
NWK								
ANA								
# of trains	12	0	0	0	0	0	0	0

11   Time from start of run to departure from station, including dwell.

| Run through – no stop.

Table 23. Operating Plan for Merced to Bakersfield Segment
Offpeak

		Train patterns for 10 off-peak hours, one-way						
Pattern#	**1**	**4**		**9**	**10**		**M1**	**M2**
Frequency of service (mins)	60	0						
	Run times from start in minutes							
SFD								
MLB								
RWC								
SJO								
MHL								
GRY								
MER	0	0						
FRS	21							
BAK	58	53						
PLM								
SYL								
BUR								
LAU								
NWK								
ANA								
# of trains	10	0	0	0	0	0	0	0

11   Time from start of run to departure from station, including dwell.

| Run through – no stop.

Segment Phasing Ridership and Revenue Results

Table 24 compares the station boardings for the alternative segment runs with the Phase 1 base run.

Table 24. Station Boardings for Segment Runs

	Phase 1 Base Run	San Francisco-San Jose	Merced-Bakersfield
San Francisco (Transbay)	32,889	6,845	–
Millbrae	2,845	2,923	–
Redwood City	4,599	2,639	–
San Jose	10,485	5,695	–
Gilroy	6,072	–	–
Merced	7,370	–	944
Fresno	6,323	–	832
Bakersfield	7,562	–	233
Total	**78,144**	**18,101**	**2,008**

■ Ridership and Revenue Modeling for Fullerton Station Option

Analysis was conducted on another scenario in which a an HSR station was introduced at the current Amtrak/Metrolink station location in Fullerton, replacing a Norwalk HSR station.

The operating pattern for the trains was kept the same as the base Phase 1 run, except for runtimes between Los Angeles Union station and Fullerton; and Fullerton and Anaheim. Tables 25 and 26 summarize the peak and offpeak operating plans for Phase 1 (Fullerton) option.

Table 25. Phase 1 (Fullerton) Operating Plan
Peak

	Train patterns for 6 peak hours, one-way							
Pattern#	1	2	7	9	10	13	M1	M2
Frequency of service (mins)	120	60	120	30	30	120	40	40
	Run times from start in minutes							
SFD	0	0	0	0	0	0	0	
MLB				13	13				13	
RWC	20			23			20	20	23	
SJO	34	30	38	34	34	34	36	
MHL												
GRY	51			55			51			55	
MOD													
MER										89	0
FRS				95	86					21
BAK				133	124					59
PLM							147	139		92
SYL						171		159		112
BUR						171	168		121
LAU	170	161	188	185	181	177		130
FUL	186		204			193		146
ANA	196		213			202		155
# of trains	3	6	3	12	12	3	9	9

11   Time from start of run to departure from station, including dwell.

| Run through – no stop.

Table 26. Phase 1 (Fullerton) Operating Plan
Offpeak

	Train patterns for 10 off-peak hours, one-way							
Pattern#	1	4	7	9	10		M1	M2
Frequency of service (r	120	120	120	30	30		75	75
	Run times from start in minutes							
SFD	0	0	0	0	0		0	
MLB			13	13	13				13	
RWC	20	23	23			20		23	
SJO	34	38	38	34	34		38	
MHL												
GRY	51	55	55			51		55	
MER									89	0
FRS			95	95	86				21
BAK			132	133	124				59
PLM			165				147			92
SYL			185			171				112
BUR			194			171			121
LAU	170	203	188	185	181			130
FUL	186	219	204					146
ANA	195	228	213					155
trains	5	5	5	20	20	0	8	8

11   Time from start of run to departure from station, including dwell.

| Run through – no stop.

Tables 27 summarizes the ridership and revenue by market for the Fullerton Station scenario.

Table 27. Annual Ridership and Revenue for Phase 1 (Fullerton)

Market	Annual Ridership	Annual Revenue (Millions of Dollars)
1 LA Basin-Sacramento	1.8	$104
2 LA Basin-San Diego	0.1	$2
3 LA Basin-Bay Area	10.5	$584
4 Sacramento-Bay Area	0.0	$0
5 San Diego-Sacramento	0.0	$2
6 San Diego-Bay Area	3.1	$179
7 Bay Area-San Joaquin Valley	7.4	$286
8 San Joaquin Valley-LA Basin	8.0	$294
9 Sacramento-San Joaquin Valley	0.6	$26
10 San Diego-San Joaquin Valley	0.1	$3
11 Within Bay Area Peninsula	4.8	$45
12 Within North LA Basin	4.8	$46
14 Within South LA Basin	1.8	$15
15 North LA-South LA	4.8	$45
18 Within San Diego region	0.0	$0
19 Within San Joaquin Valley	0.9	$24
20 Other	6.3	$256
Total	**55.0**	**$1,911**
Within entire LA Basin	*11.3*	*$106*
Within entire MTC	*4.8*	*$45*
Total between regions	***38.9***	***$1,760***

■ Ridership and Revenue Modeling for Phase 1 High End

The sensitivity of HST ridership and revenue to auto operating cost and air fares was examined in the Phase 1 High End model run. In this model run, these costs were increased by 50 percent while the HSR fares were kept constant. Table 28 summarizes the ridership and revenue from the run.

Table 28. Phase 1B High-End Ridership and Revenue Results

	Market	Annual Ridership	Annual Revenue (Millions of Dollars)
1	LA Basin-Sacramento	2.6	$148
2	LA Basin-San Diego	0.1	$2
3	LA Basin-Bay Area	14.7	$810
4	Sacramento-Bay Area	0.0	$0
5	San Diego-Sacramento	0.1	$5
6	San Diego-Bay Area	4.7	$268
7	Bay Area-San Joaquin Valley	9.5	$368
8	San Joaquin Valley-LA Basin	11.2	$389
9	Sacramento-San Joaquin Valley	0.8	$34
10	San Diego-San Joaquin Valley	0.1	$3
11	Within Bay Area Peninsula	5.4	$51
12	Within North LA Basin	5.2	$52
14	Within South LA Basin	1.3	$11
15	North LA-South LA	4.0	$38
18	Within San Diego region	0.0	$0
19	Within San Joaquin Valley	1.3	$33
20	Other	8.6	$353
	Total	**69.8**	**$2,567**
	Within entire LA Basin	*10.5*	*$102*
	Within entire MTC	*5.4*	*$51*
	Total between regions	***53.8***	***$2,414***